REMARKS

Rejections under 35 U.S.C. § 112.

Claims 14 and 16 are amended to cure rejections under 35 U.S.C. § 112.

Claims 14-21 are also rejected under 35 U.S.C. § 112 because the specification fails adequately to disclose how the spacers and strips are metallurgically bonded to one another.

Applicant submits that the expression metallurgical bond is a term well-known to one skilled in the art. One skilled in the art, i.e. a metallurgist, has knowledge of or can easily find by reference to standard texts conventional techniques for metallurgical bonding.

Applicant submits that metallurgical bonding of components is disclosed in U. S. Patent No 5921486 which uses copper brazing and high temperature diffusion welding for metallurgically bonding components in papermaking refiner plates.

United states Patent No 5954283 dated September 21, 1999 recites as its abstract and in its specification:

> Replacable refiner plates used for papermaking and refining of lignocellulosic and

other natural and synthetic fibrous materials in the manufacture of paper, paperboard, and fiberboard products. The refiner plates include blade patterns and use corrosion resistant materials, as well as ceramic and ceramic composite materials. The blades and spacers overlap to define intercontacting surfaces with the blades and spacers metallurgically bonded throughout the intercontacting surfaces.

A suitable metallurgical bond can be achieved through any of several known methods including welding, diffusion bonding, brazing, or any other method which results in a joint strength approaching that of the bladė or spacer material.

United States Patent No 4,203,315 issued May 20, 1980

recites as its abstract and in its specification:

One or a number of inserts are each fitted within a housing formed in a reference part, each insert being preferably of cylindrical shape and having a predetermined defect in density. An intimate metallurgical bond is formed between the surface of the insert and the housing by depositing a layer of copper on a steel insert when the part is of steel, and by applying a heat treatment. The reference part serves to calibrate testing instruments for ultrasonic metal inspection as well as to determine the character and size of detected defects in density.

It should be pointed out that, for the fabrication of elements to be inserted into the reference parts, recourse can be had to techniques which are conventional per se and especially to techniques which make it possible to form an intimate metallurgical bond between two flat surfaces of blocks having small dimensions. For example, it is thus possible to make use of diffusion welding in order to join two blocks together and enclose a predetermined

defect between them.

A standard metallurgy reference, Modern Metal Joining Techniques (pgs 370-373 attached), states at page 371:

> "Diffusion welding is a two stage process; plastic flow produces intimate contact and disrupts oxides; diffusion and grain growth across the original interface establish <u>the metallurgical bond.</u>"

The art of metallurgical bonding is classified in class 228, which recites the following class definition:

> This class provides for an apparatus for or a method of joining the meeting faces of juxtaposed or engaged metal work parts or of the same part originally in a form-sustaining state, by the direct application of heat and/or mechanical
>
> energy to either of: (a) <u>such work parts, to such an extent as to effect a flowing or blending together of some of the metal in neighboring regions of said work parts into a continuous metallic zone interconnecting said work parts</u>, or (b) such work parts and a metallic filler, to such an extent as to effect a flowing or blending together of the filler and some of the metal of said work portions into a continuous metallic zone interconnecting said work portions with filler and thus with each other. (Underline added)

Accordingly, applicant urges the examiner to recognize metallurgical bond as a well-recognized term in the art, to reconsider to the proposed amendment to page 7 as not being

new matter, and to withdraw the rejection of claims 13-21 under 35 USC 112.

Rejections under 35 U.S.C. § 103.

The present invention is directed to screenplates as an improvement over prior art wedge wire designs.

The present invention by means of strips and spacers joined by metallurgical bonding provides a screenplate of very fine slot width with up to 27% open area. The screenplate has a plurality of elongate strips, a plurality of elongate spacers having a thickness equal to the width of slots in the screenplate, the spacers having a width equal to the width of strips and a length less than four times the width of spacers, and the spacers being separated from each other at intervals of two to twenty times the length of spacer, the strips and spacers being metallurgically bonded at intercontacting surfaces, and the screenplate having an open area of up to 27%.

Riedel is silent on aspects of applicant's claims of record including separation of cross bars by two to twenty times the length of cross bars, open area of up to 27%, the spacer cross bars having a length less than four times their width.

Riedel provides neither the motivation nor the teaching or inference of applicant's screenplate. The only source of such teaching is applicant's disclosure which is not a proper basis for modifying Riedel.

Malm provides gaps 12 of 0.05 to 1.0mm which can be seen as providing a very small open area with respect to total width of bar shaped elements 11. In the time elapsed between Riedel and Malm, Riedel has contributed nothing in the field to suggest papermaking screen plates with open area up to 27%.

The examiner is urged to allow the claims over Riedel and the combination of Riedel and Malm.

Stamford, Connecticut
March 17, 2004

Respectfully submitted,

3/17/04.

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Modern Metal Joining Techniques

MEL M. SCHWARTZ
Martin Marietta Corporation

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Chapter 9

DIFFUSION WELDING

Product requirements in the aircraft, missile, electronics, nuclear, aerospace, and commercial fields have given rise to many new and demanding service conditions. To meet the stringent requirements of these exacting operations, it was not only necessary to develop new materials but, equally as important, methods to fabricate them into useful engineering components. One such fabrication technique, diffusion welding, was developed to keep pace with the requirements of the advancing technology.

Fusion welding and brazing have been the workhorse techniques for such joining in the past. Each of these techniques, however, may alter the uniformity of properties in the fabricated structure and often have undesirable joint properties such as low strength and low remelt temperature. Recently, however, solid-state welding has been receiving considerable attention for many applications.

Diffusion welding per se is not a completely new joining technique. The forge welding processes have been used to join both wrought iron and low carbon steels for many years. In fact, forge welding is one of the oldest joining methods known and was the only process in common use before the nineteenth century. It is interesting to note that the famous "Damascus blade" of medieval times was made by forge welding.

Frequently, when a new process is publicized in the technical journals, many people tend to use it prematurely. This approach can be disastrous. The initial investigations are usually conducted on a laboratory scale and most likely require additional development. The reported technique may only be applicable for a specific problem, and so each new application demands additional development. Obviously, it would be wise to secure

as much available information as possible on the subject and judiciously apply it to the present problem.

In addition, a number of terms are in use to describe various forms of diffusion welding: solid-state diffusion bonding (creep controlled utilizing low pressures and long bonding times), solid-phase bonding, pressure welding, gas pressure bonding, isostatic bonding, press bonding, roll welding, forge welding, explosive welding, friction welding, diffusion bonding, deformation welding (yield strength controlled utilizing high pressures and short bonding times), diffusion welding, and diffusional bonding. A more detailed differentiation of the processes mentioned is discussed under the section on mechanisms and key variables of diffusion welding.

THEORY AND PRINCIPLES OF PROCESS

Unfortunately, the term "diffusion welding" has frequently been misused and applied to processes in which melting occurs or in which the temperature approaches the solidus point that the melting of segregates can be assumed. The following general conclusions can be drawn from the literature.

Diffusion welding is a two-stage process; plastic flow produces intimate contact and disrupts oxides; diffusion and grain growth across the original interface establish the metallurgical bond [1,2]. It has been theorized that diffusion is not necessary for bonding to occur, because bonding will result by mating two clean, perfectly flat surfaces [3]. That this theory is clearly not true is shown by the lack of bonding between an alumina anvil and tungsten under conditions that cause excellent bonding of two tungsten sheets. The mutual insolubility of alumina and tungsten appears to inhibit atom transfer. It follows therefore that intimacy of contact is inadequate if diffusion-inhibiting films remain on the surfaces.

Intermediate metals with low yield stress aid in achieving intimacy of contact [1]. In addition, low yield stress intermediate metals permit deformation to be restricted to the intermediate metal so that distortion can be minimized. One of the principal effects of higher bonding temperatures is to lower the yield stress of the intermediate metal.

Surface diffusing elements accelerate diffusion bonding. Experimental work on tungsten showed that electroplates a few microinches in thickness of either nickel, palladium, rhodium, platinum, or ruthenium accelerate bonding [4]. All joints made at 900 and 950°C with a maximum heat treatment time of 4 hr failed at the joint without any fracture occurring in the base metal. At 950°C, however, recrystallization was observed after a 4-hr heat treatment. The structure produced at 1100°C is shown in

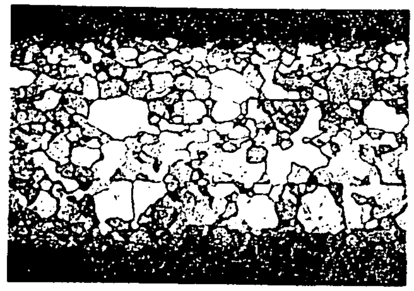

Figure 9.1 Joint from 1100°C hr with nickel on undoped tungsten. Copper ammonium sulfide etch [12].

Figure 9.1 for undoped tungsten. The 4-hr sample shows clear evidence of the joint line disappearing and penetration of the recrystallized region.

The quality of the joints and the extent of recrystallization for joints made with palladium are essentially the same as those with nickel described in the preceding paragraph. Recrystallization which accompanies bonding by this process results in a loss of room temperature ductility. Data also indicate that palladium like nickel lowers the recrystallization temperature of tungsten to 1000°C, even in the presence of a doping agent. The extent of the recrystallized zone increased with both time and temperature of heat treatment. After a 2-hour 1100°C heat treatment, the strips were completely recrystallized and the bondlines obliterated.

It is apparent from the experimental results that an "activating agent" such as nickel or palladium must be present to cause tungsten-to-tungsten bonding because no joints can be made in their absence at the temperatures employed. Evidently this process is one in the solid state since the minimum melting points in both the nickel-tungsten alloy system and in the palladium-tungsten system are those of pure nickel and palladium, respectively [5,6]. The enhancement of tungsten diffusion by the presence of nickel or palladium leads to the development of tungsten "bridges" across the joint. This diffusion process is accompanied by recrystallization at as low a temperature as 1000°C.

On the other hand, surface diffusers are usually grain boundary diffusing elements and lead to unstable grain boundaries in the metal being joined. Consequently, hot shortness, recrystallization, and grain growth are problem areas with this type of accelerator.

Volume diffusing elements with high diffusion rates accelerate diffusion welding. Small interstitial atoms can rapidly diffuse along lattice interstices [7] and along grain boundaries adjoining the interface and can irrigate

(diffuse laterally) into the interstices of the lattices of the grains that border along these boundaries [8]. Substitutional atoms of different elements can volume diffuse by a vacancy jump mechanism [7] at a slower rate into adjoining base alloy materials.

If the interdiffusing elements are substitutional and soluble in each other, the conditions shown in Figure 9.2 might prevail. This figure shows that, after sufficient time at temperature, a "mixing" of the atoms has occurred with the mutual atomic attraction of the atoms across the interface producing the bond. This schematic, of course, represents only the simplest conditions that would prevail for diffusion welding to occur and does not consider other factors that may affect the diffusion processes, such as dislocations, atomic and grain misorientations, grain boundaries, voids or the possible formation of either intermetallic compounds or low-melting solid solutions, and eutectics or peritectics that could melt at the diffusion-welding temperature.

Sometimes initial diffusion of an element into a base metal may result in the formation of a low-melting solid solution, eutectic or peritectic composition. The low-melting composition may then fill the joint and constitute a "pseudobrazing alloy." The diffuser element may then again migrate into the base metal from the liquid alloy. In another type of reaction the

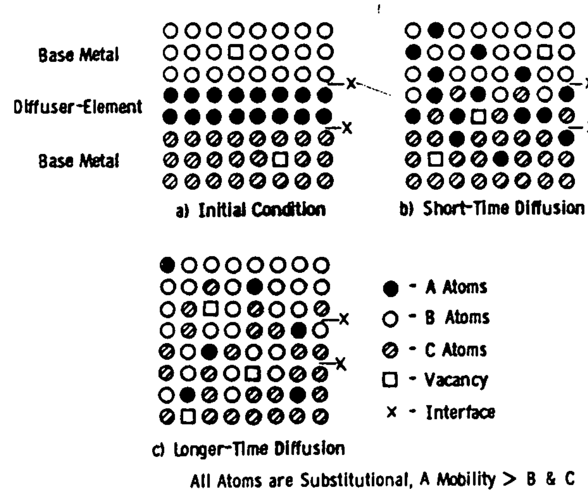

Figure 9.2 Nature of the diffusion-bonding mechanism when "primary" diffuser-element has been preplaced at the interface. Idealized condition in which atoms of the separate regions are oriented and substitutional [15].